(Nature, April 27). He adds, as an explanation, that "the average college don" forgets an elementary law of friction. But the proper inference is that the definition of the reviewer is different from that in common use. It is difficult to believe in this general forgetfulness.

The various letters sent to Nature sufficiently show what meaning is usually attached to the words.

June 3. E. J. Routh.

WHY JAPAN IS VICTORIOUS.

TEN years ago, after the conclusion of the war between Japan and China, it was remarked that the sound of the Japanese cannon at the mouth of the Yalu River awoke the nations of the world to the fact that a new Power had arisen in the Far East which in future would require to be taken into account when any political problems arose. It is, of course, recognised by all who know modern Japan that the most important factor in the making of new Japan has been the applications of science to the arts both of peace and war. Without these, even the spirit of the samurai would have been as powerless before the attacks of Western Powers armed with all the latest warlike appliances, as were the dervishes at the battle of Omdurman. Spectators speak with admiration of the bravery of these men and with pity that their lives were thrown away in a vain resistance. Without the help of science and its applications it is very certain that, before this time, Japan would have been overrun by a European Power after immense slaughter, for the last man would have died, fighting with his primitive weapons, rather than recognise a foreign domination.

A careful study of the evolution of modern Japan shows plans founded on enlightened principles and carried out in every detail. In fact, one of the secrets of the success of the Japanese in the present war is that nothing is left to chance; every detail is worked out and carefully provided for. They soon recognised that their national ideals would never be realised without a system of education, complete in every department, which would supply the men who were required to guide the nation under the new conditions which had emerged. Elementary education was organised all over the country, secondary education in central districts, and technical education wherever it seemed to be required. Above all, there are two national universities which in equipment and quality of work done will bear favourable comparison with similar institutions in any other country in the world.

The educational work of the country was directed not simply to personal or sectional purposes, as is unfortunately too often the case in the West; it was also consciously directed to the attainment of great national ends. Every department of the national life was organised in a rational manner, and, therefore, on scientific principles. In many departments there is still much to be done, but past achievements promise well for the future.

Special attention has been paid by the Government to the applications of science. Without the railways, the telegraphs and telephones, the dockyards, the shipbuilding yards, the mines, and the engineering establishments, the existence of the army and navy would have been impossible; at least, if they did exist they would have been nearly powerless. The operations of the present war with Russia have clearly demonstrated the importance of the introduction of the scientific spirit into all the national activities. The railways which have been built in Japan have been fully utilised to convey men and materials and the ships to transport them oversea. The telegraphs have been used to communicate instructions and to keep the authorities informed regarding movements and requirements. The dockyards and shipbuilding yards have been ready to undertake repairs, and the arsenals and machine shops to turn out war material of all kinds, as well as appliances which aid operations in the field. Light railways have been laid down on the way to battlefields, and wireless telegraphy and telephones to convey instructions to the soldiers; in short, all the latest applications of mechanical, electrical, and chemical science have been freely and intelligently used.

The Japanese have not only modified Western appliances to suit their conditions, but they have also made numerous distinct advances. The ships of their navy are probably the best illustration of the Japanese method of procedure. In naval matters they accepted all the guidance the Western world could give them, but at the same time they struck out a line of their own, and the fleet which they have created is unique in the character of its units. British designs have in many respects been improved upon, with the result that they have obtained in their latest ships many features which have won the admiration of the world. The training of Japanese naval officers is very complete in every way, and in some respects offers an example to the British authorities, and the men are devoted to their profession. Japan now sends her picked men to Europe to complete their studies, so that in every department of national life they are kept up with the latest developments. The siege of Port Arthur, the battle of Mukden and the other battles in Manchuria, and the exploits of the Japanese Navy prove most distinctly that they have profited by their experience.

The intense loyalty of the Japanese, which compels them to make any sacrifice, combined with their great intellectual ability, enables them to take full advantage of the modern science and organisation necessary for the attainment of the objects of their ambition. Their great power of foresight prepares them for all their enterprises, both of peace and war, with exact and scientific precision. While they are permeated by Eastern ideas they have been able to appropriate much that is best in Western thought, and thus they unite many of the best qualities of the East and the West.

The lesson which our educationists and statesmen have to learn from Japan is that the life of a modern nation requires to be organised on scientific lines in all its departments, and that it must not be directed chiefly to personal ends, the attainment of which may, to a large extent, intensify many of our problems, but that it be consciously used for the promotion of national welfare.

But though the lesson is plain enough, apparently it is not understood by those whose business it is to promote national welfare by guidance or counsel. With one consent our newspapers have attributed Japanese success to all reasons except the right one; and, instead of opening the eyes of the nation to our pressing needs and deficiencies, they have been blind leaders of the blind. Our public men and our Press will not see that scientific education has brought Japan to her present position in thirty years, and that, if we choose to educate ourselves, we may arrive at the Japanese standard of national efficiency. The progress which this country has made since the Middle Ages is due to the discoveries of men of science, whose work has been done in spite of discouragement or national indifference. In the new atmosphere of Japan a scientific spirit prevails, which encourages development, with the result that the nation has in a generation arrived at a position which has taken us centuries to reach. It is not compli-

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mentary to us as a nation to say that our patriotism, fear of death, or nerves compare unfavourably with similar attributes of the Japanese; and, after all, this is a matter of opinion. The fact to face is the transformation which science has effected in Japan, and the sooner our statesmen are educated to see it, the more promising will be the outlook for the British nation.

SOLAR CHANGES AND WEATHER.

DURING the last few years more than usual attention has been paid to the question of the relationship between sun-spots or prominences and "weather," and to the possibility of being able in the near future to forecast the characters of approaching seasons. Quite recently in this Journal (vol. lxxi. p. 493, March 23) we referred briefly to a pamphlet published by the United States Department of Agriculture, Weather Bureau, summing up the general state of the problem of long-range weather forecasting. In this it was stated that advances in the period and accuracy of weather forecasts depend upon a more exact study and understanding of atmospheric pressure over large areas, and a determination of the influences, probably solar, that are responsible for normal and abnormal distributions of atmospheric pressure over the earth's surface.

In the April number of the *Popular Science Monthly* the question of the relationship between sun-spots and weather is summarised in an article by Prof. Ernest W. Brown, of Haverford College. In this we have an interesting account of the problems waiting solution, and he brings together in a very clear manner a general survey of the relationship, or rather non-relationship, as he concludes to be the case. Thus he says, "it is highly probable that the direct effect of the spotted area is unimportant compared with the effects produced in our atmosphere by other causes." In his final summing up he remarks that his opinion is expressed by Prof. Cleveland Abbe, who stated that:—"The key to the weather problem is not to be found in the sun or indeed in any external influence, but that the solution is to be worked out by the conditions which hold in the atmosphere itself—conditions which can only be discovered by a thorough examination of the internal laws of motion, quite apart from any external forces which may modify the results."

In referring to the difficulties which are met with in examining the meteorological conditions on the earth's surface, Prof. Brown points out that observations made "at one place should be kept separate from those at other places, for it is theoretically possible and even probable that a maximum at one place of observation may occur at the same time as a minimum at another place. For example, the yearly averages might show that a maximum rainfall in one place always occurred with a minimum rainfall in another and *vice versâ*."

In the last quotation Prof. Brown makes a suggestive remark which recent work has shown to be an actual meteorological fact; it has already been completely established for pressure, and must therefore hold good as regards rainfall, since the latter depends on the former.

In the case of these variations of barometric pressure it has been shown, and referred to at some length in this Journal (vol. lxx. p. 177, June, 1904), that there exists a barometric see-saw on a large scale the presence of which has been amply corroborated by Prof. Bigelow, of the United States Weather Bureau. There seems little doubt that it is this pressure change that will eventually prove the "key" to the situation, and its solar origin has already been suggested in the changes in the frequency of prominences, which are, after all, allied to sun-spots.

Up to the present time those who have been attempting to explain variations of weather on the supposition of solar changes have been looking for the effect of solar action as either increasing or decreasing simultaneously the rainfall over the whole earth. The consequence has been that a study of a great number of statistics has shown that in some regions the rainfall varies directly with the number of sun-spots, and that in others the variation is inverse, while, again, in other parts there seems to be no apparent relation at all. In fact, these deductions, though quite correct, have led to the conclusion that the solar connection is of a very questionable character, as it was considered impossible for such opposite results as the first two just named to have their origin in one solar change.

It is the employment of this incorrect working hypothesis that has probably retarded the progress of the study of the connection between solar and meteorological changes.

The now recognised existence of this barometric see-saw shows that the sun's action must have a *double* effect on our atmosphere, and this of an opposite nature. Such a result is quite natural, and it is curious that use has not been made of it before.

When it be considered that the amount of air in our atmosphere is a constant quantity, a greater piling up of it on one side of the earth must necessarily mean a diminution in the antipodal regions. If greater heating power of the sun takes place, then the atmosphere must also be heated to a greater extent, and consequently more intense up-currents of warm air are formed, resulting in more pronounced low-pressure areas. There must, however, be a compensating effect somewhere, and this is found on the opposite side of the earth when the previously heated air arrives, descends, and creates an area of excess pressure.

This backward and forward transference of air becomes, therefore, of great importance in studying the weather changes in any one region, because the rainfall phenomena are so closely related to the pressure changes.

Away from the middle portions of those two large areas which behave in this see-saw manner, the variations of pressure should, and actually do, have a different periodic nature. It is of extreme importance, therefore, when trying to trace the sun's action on our atmosphere, to separate the regions over which the variations may be truly solar from those which exhibit variations modified by the mechanism of the atmosphere itself.

There is therefore no reason why we should take a pessimistic view of the attempts made to solve this fascinating riddle of the relationship between changes of solar activity and the vagaries of the weather. An enormous amount of accumulated material is ready for discussion, and efforts should be made to secure the continuity of these observations and at the same time to coordinate the data along lines most suitable for this particular research.

WILLIAM J. S. LOCKYER.

THE SURVEY OF INDIA.[1]

THE extracts from the narrative reports of the Survey of India for the years 1902–3 are contained in a thin and attenuated volume of some eighty pages, which, as compared with previous reports, represents the effects of Indian financial economy applied to one of its most interesting departments.

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[1] "Extracts from the Narrative Reports of the Survey of India for the Season 1902–3." (Calcutta: Government Printing Office, 1905.) Price 2*s*. 3*d*.

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